Intracranial Complications of Otitic Origin

C. W. Earle Beals, M. D.

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There are certain intracranial complications of otitic origin that will be met with in the practice of every aurist, and every aurist should therefore be prepared to cope with any that might occur. Kerrison[1] mentions these complications in the order of the frequency with which they occur as follows: extradural abscess, infective sigmoid sinus thrombosis or phlebitis, cerebral abscess, leptomeningitis, cerebellar abscess. In a series of cases of intracranial complications of suppurative otitis media, observed by Yerger[2] at the Cook County Hospital, during the decade from 1911 to 1920 inclusive, meningitis was found to be the most frequent complication, Sigmoid sinus thrombobis was second in frequency and brain abscess was third.

When we study the anatomy of the middle ear, we can understand what a ready means for the extension of septic inflammatory disease is provided by the peculiar position and relations of the various parts of the interior of the ear. These infective processes generally originate in chronic purulent disease of the middle ear; they more rarely attend the acute stages of the disease, but not as frequently as they follow the chronic type-- e. g. sinus thrombosis is more frequent in acute conditions.

The pathways of infection are various. Pus in the middle ear may travel different routes and produce in its course the several brain lesions.

Its route, by osseous erosion of the thin roof of the tympanum or antrum, is followed by a collection of

Pus between the bone and dura, forming an extra dural abscess. A later development, by further extension of the lesion, gives rise to a subdural abscess which may continue into the substance of the brain, producing brain abscess.

Erosion may take place in the bony wall of the mastoid process which lies over the sigmoid sinus, giving rise to a collection of pus (perisinus abscess) between the bone and sinus wall or to the formation of a thrombus in the sigmoid sinus itself.

The infective process may travel backward forming an extradural abscess of the cerebellum and, as a later development of this lesion, a cerebellar abscess.

Passing downward, either from the mastoid or by direct extension from the tympanic cavity, the infection may give rise to a septic lesion in the jugular bulb.

Dr. Hewson, in his lectures, emphasizes the especial liability of the child to intracranial complications by reason of the ready pathways afforded by the sutures.

Two or more of the avenues of infection may be followed in the same patient, each producing a separate and distinct lesion. This is illustrated in the case of John Murphy which is reported in this paper. Progressive extension of the infective process may produce many lesions in one individual, as is illustrated in Dr. Shuster's[3] case.

Another very important pathway is furnished by the intermediate infection of the labyrinth. Pus from this point may reach the cranial cavity by three routes. It may travel by way of the nerve channels into the internal auditory meatus, from the cochlea by way of the aqueductus cochlea or from the vestibule through the aqueductus

vestibuli. By thrombosis of the small veins of the internal ear, infection might be transmitted to the jugular bulb through the cochlear vein. No mention has been made of this in the literature, probably, because of the minute size of the vessel. The internal auditory vein is occasionally mentioned as a route of infection, and it may also travel by way of the pneumatized petrous pyramid.

The intracranial complications will be considered in the following order: meningitis, sinus thrombosis and brain abscess.

Meningitis, one of the most distressing afflictions with which the otologist has to deal, has for many years been a trying problem, and indeed, no doubt will remain so until the physiology of the cerebrospinal fluid is better understood and new means devised to cope with the infection. Gradenigo[4], Luca[5], Kopetzky[6] and others have reported cases presenting typical symptoms of leptomeningitis of otitic origin which have recovered after operation. However, because of the difficulty of differentiating the diffuse form of leptomeningitis from the circumscribed, the question arises as to whether or not the cases successfully treated by surgical intervention, were not of the circumscribed variety.

Meningitis of otitic origin may be classified into two large groups: imflammation of the meninges of a protective type, and inflammation of the meninges of a destructive type. The classification as given by Kopetzky[7] is as follows:-

1. Protective Meningitis (Meningitis Sympathetica) occurs in conjunction with
   - A. Extradural abscess
   - B. Intrameningeal abscess
   - C. Sinus thrombosis
   - D. Brain abscess

2. Suppurative Meningitis (Dangerous)
   - A. Local. Intrameningeal abscess.
   - B. General. Purulent leptomeningitis.
   - C. Acute. All acute suppurative conditions of the intrameningeal spaces.
   - D. Chronic. Suppurative conditions of the intrameningeal spaces which for the time being are rendered quiescent by virtue of the protective mechanisms of the meninges.
   - E. Fulminating. A suppurative meningitis associated with bacteremia and marked cerebral derangement, death occuring as the result of the sudden derangement of the vital cerebral center.
   - F. Exudative. In addition to the suppuration in the subarachnoid space, with the free circulation of microorganisms, there is evidence of a protective exudate formed by the meninges themselves.

Extradural abscess is the most common of all the otitic inflammations of the meninges. It is the first step in the pathway by erosion in the production of a meningitis either sympathetic or dangerous.

This type of meningeal inflammation is most commonly found between the tegmen antri and the dural covering of the temporal lobe. Next in frequency is the epidural spaces of the posterior fossa. A rarer situation, but one which must be borne in mind, is a pus accumulation over the apex of the petrous portion of the temporal bone.

The symptoms of extradural abscess are many times more frequently absent than present and, indeed, the lesion is frequently not suspected, until at operation an erosion or fistula is found in the bond. On the other hand, the symptoms may simulate a purulent leptomeningitis as is shown in the case reported by

McDougall.[8]

The symptoms which may be present are, severe , localized pain and headache, usually confined to the side of the lesion, and elevation of temperature. In cases occuring in the region of the sinus, with solid bone intervening, both rigors and elevation of temperature may occur, even where there is no evidence of a sinus thrombosis.[9] One symptom, not given the prominence it deserves, is an excessive outflow of pus from the ear, welling out immediately after syringing and drying.

The physical signs of value, and these are inconstant, are, pain upon pressure and increased pain upon tapping.

An extradural abscess is very often productive of a protective meningitis or a circumscribed pachymeningitis. When this is the case, the focus should be uncovered by removal of bone until healthy dura is seen. When thoroughly exposed and the purulent collection evacuated, there will usually be a rapid subsidence of the meningeal reaction.

When the irritant is not removed and ulceration of the dura is permitted to advance, an intrameningeal or subdural abscess will be formed.

An intrameningeal abscess may be considered as a suppurative process in which the protective forces of the meninges have localized the infection. It is never the end result of a leptomeningitis which has localized, but is the result of an infection from without, inward. It is amenable to surgical intervention and treatment as is shown by the cases reported by Kopetzky,[10] Macewen,[11] and others. This type of abscess is rarely diagnosed

before operation.

Should an intrameningeal abscess continue inward in its progress, it would rupture into the subarachynoid space causing a purulent leptomeningitis.

Purulent leptomeningitis is a diffuse infection of the pial and arachnoid membranes. The inflammatory products are deposited in the arachnoid space. There are two types, the fulminating and the exudative.

The fulminating type of leptomeningitis is either secondary to, or concomitant with, a general blood-stream infection. It is usually due to the Streptococcus mucosis and the infection is so sudden and virulent that the protective forces of the meninges have had no time to prepare for the invasion.

The exudative type of leptomeningitis is commonly of otitic origin and is secondary to bony erosion. The meninges have had time to form protective barriers, and the exudate present in the subarachnoid space is the result of both the bacterial activity and the protective mechanism of the meninges.

In contradistinction to the fulminating type, the exudative form may exhibit periods of remission during which the patient appears to be on the road to recovery.

Death, in the exudative type of meningitis, is produced by sepsis, a large part of which is furnished by the highly toxic lecithin derivatives created by degeneration of brain tissue. As opposed to this, death, in the fulminating type, is sudden and is produced by a progressive inflammation of the brain cells which destroy their function.

The symptoms of meningitis may be briefly mentioned. Pain in the head is an early, severe, and persistent

symptom. There is little to distinguish it from brain abscess, in the early stages. In brain abscess the pain is severe at the onset but it usually soon disappears. If it persists it becomes a dull boring pain rather than the sharp pain of meningitis.

Vomiting is rarely absent and, like vomiting of brain abscess, it is cerebral in type.

Chilly sensations are usually present if careful inquiry is made. The intense and frequently repeated rigors of infective sinus thrombosis are wanting.

The face is flushed, the temperature is usually high, and its degree is variable, but it is not liable to such violent fluctuations as in septic thrombosis. The pulse is usually rapid and irregular. The respirations are rapid, except in leptomeningitis of the cerebellar fossa, when they are slow or of the Cheyne-Stokes type.

The mental functions are much involved. There may be drowsiness but the sleep is fitful. Extreme restlessness, maniacal excitement, constant movement in bed, irritability and delirium may be noted.

The typical case is unusual and one must remenber that the whole of these symptoms may not be present in any individual case. Meningitis may be associated with abscess of the brain, sinus thrombosis, or the symptoms may be modified by pressure.

In the uncomplicated case the contrast with brain abscess is striking; the delerious excitement, quick pulse, high temperature, and rapid respirations of meningitis and the deep drowsiness, slow pulse, subnormal temperature, and

slow respirations of brain abscess.

Certain aids to diagnosis have been brought out in the recent literature. The characteristics of the spinal fluid in the various types of meningitis as classified by Kopetzky[12] in his summary brings out valuable diagnostic points.

Yerger considers the following points, based on his observation at the Cook County Hospital, of 155 cases of meningitis, 43 cases of lateral sinus thrombosis, 35 cases of extradural abscess, 2 cases of cavernous sinus thrombosis and 1 case of subdural abscess, a valuable aid, in conjunction with other data.

A sterile cerebrospinal fluid with a low cell count (from 25 to 250) excludes a suppurative meningitis, but throws suspicion on the presence of an extradural or brain abscess; in a medium cell count (from 250 to 2500), one should suspect a subdural or brain abscess or meningitis; but, in the high (over 5,000) and very high (over 10,000) cell count, a diffuse suppurative meningitis is usually present. The higher the cell count, the more certain is the diagnosis of diffuse septic meningitis. A diffuse meningitis is considered clinically proved when bacteria are found in the cerebrospinal fluid.

Greenfield[14] states that the prognosis previously has rested too much on the presence of bacteria in the cerebrospinal fluid. If either the pneumococcus or streptoccocus (virulent forms) are recovered from the fluid and can be grown on culture mediums, the prognosis is always bad. The pneumococcus always kills and the same may be said for the virulent forms of streptococci. But

he states that there is a large group of cases which give no growth or at most, but a few colonies of a less virulent germ. Therefore, the only test which gives us any prognosis in such cases is the chlorid percentage.

He believes that the chlorids always fall when meningitis becomes generalized, and therefore so long as they remain high there is ground for belief that the area of inflammation in the meninges is localized.

Jervell[15] describes a method of diagnosis which is simple and should prove of value. He bases his method on the permeability of the meninges to uranin. Two gm. of a 20% solution of uranin is given by mouth or intramuscular injection. If, by lumbar puncture three hours later, the spinal fluid shows distinct greenish fluorescence, the presence of meningitis can be assumed with great probability.

The treatment of meningitis is surgical, and surgical intefvention is yet in its infancy. Eagleton[16] has accomplished this by opening, draining and irrigating the subarachynoid space. A trephine opening is made in the frontal region, the cysterna magna entered by needle and stylet replaced as soon as a flow of fluid is obtained. A lumbar puncture is made in the usual manner. An inlet canula is inserted in the frontal opening, all stylets withdrawn and irrigation begun through the canula in the frontal opening.

Usually, following this procedure, there is for a day or two a marked improvement. Dr. Shuster's[17] case was unconscious and needed no anesthetic for the operation. The following two days showed marked improvement.

In a recent article Eagleton,[18] in addition to the above, advocates the replacement of the evacuated fluid by a modified Ringer's solution, at the body temperature; the placing of the parts at rest by ligation of the internal or common carotid artery of the same side, with ligation of the jugular if there is any suspicion of a venous origin; and the subsequent performance of repeated lumbar punctures. This is to be associated with repeated, small transfusions of blood from an immunized donor.

Spinal puncture, as advocated by Van der Wildemberg[19] in his report of recovery of a few cases of meningitis of otitic origin, is of value. He believes that the most important measures are accurate observation of the patient, repeated spinal punctures and removal of the inflammatory focus.

The earlier the diagnosis is made and treatment instituted, the better the prognosis. The course of the disease is influenced by the virulence of the bacteria. Cases of otogenic meningitis accompanied by sinus inflammation have the most favorable prognosis. The fulminating type offers no prospect of successful treatment.

The Gradenigo Syndrome points out a type of meningeal involvement which is a clinical entity in itself. The lesion is an inflammation of the dura with a plastic exudate or with pus formation (extradural abscess) over the tip of the petrosal pyramid, originating in the middle ear or mastoid and transmitted through cells beneath the semi-circular canals to tip.

The symptoms, which are of surgical significance only in the presence of a middle ear suppuration, are involve-

ment of the sixth nerve causing a weakness or paralysis of the abducens or external rectus muscle and double vision. Pain, also is a symptom in all cases. This is due to an involvement of the Gasserian ganglion causing the production of pain along the course of the branches of the fifth cranial nerve. The presence of ear or mastoid disease is necessary to complete the picture of a Gradenigo Syndrome.

The treatment consists in careful watching, absolute rest in bed in a darkened room, and care of the ear and mastoid without delay.

The following cases illustrate the Gradenigo Syndrome:

Case 1. Lucelle Schwem

Case 2. Selma Harris

Another case, seen in the practice of Dr. M. S. Ersner, in the Medico-Chirugical Hospital, presented typical symptoms of Gradenigo Syndrome. This was a child one year of age, with acute suppurative otitis media, who was brought to the office because the mother noticed a tendency of the right eye to turn in. Symptoms promptly subsided after mastoidectomy.

Case No. 1.

Gradenigo's Syndrome Following Acute Coalescent Mastoiditis

Lucelle Schwem.

Girl, aged 10, Admitted to the service of Dr. Beals, Maple Avenue Hospital, Du Bois, Pa., March 14, 1925.

History: Following an attack of acute coryza, the patient complained of pain in the right ear. When seen

by the writer about ten days later, there was a marked bulging of the membrana tympani. A myringotomy was done in the office. For three days following there was a most profuse discharge of pus from the ear, definite mastoid tenderness was noted, and the patient was sent to the hospital. Tem. 102.6, pulse 115, respirations 22.

Because of the very definite signs of mastoid involvement, a simple mastoidectomy was done on March 16th. The mastoid was of the pneumatic cellular type. The cell walls were intact but each was filled with thick white pus. The sinus plate was intact and no necrotic area was noted over the tegmen antri. It was an acute coalescent type of mastoiditis.

The postoperative period was not the usual one. The course appeared to be normal for five days when the temperature became septic, ranging between 99 and 102. During all this time the patient looked well. There was an extremely profuse discharge of pus from the middle ear and mastoid.

On March 30th the wound was opened and many flabby and unhealthy granulations removed. Following this there was little change in the condition of the patient.

There were few symptoms presented by this patient and she appeared comfortable. She was up and about her room part of the day.

The profuse discharge continued with a slightly septic temperature.

On April 9th the wound was again opened and considerable necrotic bone was found in the zygomatic region. There was a fistulous tract leading from the middle ear

but no involvement of the internal plate. Considerable bone was removed over the temporal and anterior zygomatic regions. The internal table was intact. Sinus plate appeared normal and sinus was not exposed.

The patient reacted well from the operation. The temperature reached 102 and then gradually dropped to normal in four days. For the next two weeks there was little change in the condition of the patient. The temperature appeared mildly septic in type, fluctuating between normal and 101.

On April 30th it was noted that the patient had a paralysis of the right external rectus. She complained of no double vision and of only occasional attacks of pain. The treatment was rest, in bed.

On May 17th the patient was discharged from the Hospital, improved. There seemed to be less tendency for the right eye to turn in and discharge from the mastoid wound had stopped. However, pus continued to discharge from the middle ear.

On tonic treatment the patient gained in weight and the discharge from the ear stopped. All trace of paralysis of the sixth nerve disappeared.

Comment: This case illustrates the type of acute coalescent mastoiditis. In this type operative measures should not be undertaken, as a rule, before ten days or two weeks have elapsed from the time of onset. Nature

The symptoms of sixth nerve paralysis were probably caused by a swelling or serious involvemant of the nerve at the apex of the petrous portion of the bone.

The striking feature of this case was the great amount of pus which continued to discharge after mastoidectomy.

Another feature was the rapid clearing of the infection when proper measures were directed toward the building up of the general health.

Case No. 2.

Selma Harris

Gradenigo's Symptom Complex following Simple Mastoidectomy

Girl, aged 8, Admitted to Medico-Chirugical Hospital, March 20, 1924, service of Dr. G. M. Coates, under care of Dr. M. S. Ersner.

History; Following an acute rhinitis, of about two weeks duration, a double acute purulent otitis media set in. Myringotomy was done on both sides. The left cleared up but on the right side there appeared symptoms of an acute mastoiditis.

A simple mastoidectomy was done on February 14th, with a characteristic reaction and gradual fall of temperature to normal. The patient was discharged from the hospital on Feb. 26th.

On March 16th when seen by Dr. Ersner, she complained of photophobia in right eye and of headache. Three days later she complained of diplopia and it was noticed that the right eye turned in.

Operation: On March 22nd Dr. Ersner operated, incising and removing the old scar over mastoid. The middle fossa was exposed and the dura found normal. The roof of the mastoid appeared normal. The sinus plate was removed and the lateral sinus exposed. The wall of the sinus appeared congested and had a redish tint. Pulsation was present. It was thought inadvisable to explore sinus.

The temperature was of the septic type and on the 22nd, a few hours after operation, there was a chill. The temperature continued septic until March 30th when it reached normal and remained there. For one week following the operation there was considerable drainage from the mastoid wound. This slowly lessened, the papillitis gradually subsided, and the abducens paralysis became progressively less. The patient was discharged April 26th.

Comment: This case presented a problem similar to case one; a persistence of symptoms after mastoidectomy. However, there was less pus and the infection had apparently caused no bony erosion. The dura and sinus were exposed because the symptoms were somewhat suggestive of an extradural abscess. There was probably in this case, either an extradural abscess or collection of serum at the apex of the petrous portion of the temporal bone. Prompt operative interference with the establishment of good drainage brought about the relief of symptoms.

Infective Phelbitis and Sinus Thrombosis

There are two distinct pathological forms of intrasinus infection, viz., infective changes of the inner

coat without clot formation (infective sinus phlebitis) and infective clot formation (infective sinus thrombosis).

Three factors are necessary for the production of an infective thrombus in a vein: slowing of the blood stream, trauma to the endothelial lining of the vessel and the presence of pathogenic microorganisms.

There are two routes of invasion in the formation of a thrombus; extravenous, in which the infection extends to the vessel by contiguity, and intravenous, which produces its lesion by thrombosis of the small veins which extend into the lumen of the larger vessel.

Thrombosis by the extravenous route is secondary to the coalescent type of acute and chronic mastoiditis. The inflammatory process gradually progresses toward the large venous channel, the sinus plate is broken down, the vessel is compressed, the lumen narrowed and the blood stream slowed. By further extension, the vessel wall becomes involved and the infection produces trauma. Nature makes an effort to limit the process and a thrombus is formed. The organisms invade the center of the thrombotic mass, therefore, the center of the thrombus becomes, at first, the seat of pyogenic microorganisms while the periphery is sterile.

All thrombi, pathologically considered, are infective, though, from a clinical standpoint there may be the non-infective or sterile type.

The intravenous type is secondary to an acute hemorrhagic mastoiditis. The sequence of events is very definite. The disease attacks the venous supply of the mastoid process at the outset and limits itself to the vessels. Minute thrombi fill the venules of the mucosa and the

mastoid cells are not involved in the lesion except as an intense engorgement of the mucosa and the filling of the cells with serum.

By extension, the thrombi invade the veins of the bony walls and produce a condition known as osteothrombotic phlebitis. From this point, the thrombi extend into the lumen of the larger vessel and there are at once produced the factors necessary for throbus formation; narrowing of the lumen, trauma and infection. Such a thrombus is more likely to be of the mural variety than that produced by the extravenous type. The infective organism is always a hemolytic streptococcus.

With this view of the mechanism of thrombus production, one can easily understand the symptoms produced by each type.

Detailed description of the symptoms of sinus thrombosis will not be taken up but a review of the diagnostic points only will be considered.

The extravascular type follows an acute coalescent or chronic mastoiditis. When a mastoidectomy is performed there occurs a distinct interval of time before the temperature becomes septic and signs of sepsis intervene. At the time of operation, signs of a destructive lesion are found.

The prodromal signs are: headache over the parietal and occipital areas, the appearance of edema over the mastoid process preceeding operation (Griesinger's Sign), and chilly sensations followed by a rise in temperature.

Definite signs of sepsis soon supervene. A violent chill usually ushers in the disease. It is followed

by a rise in temperature to 104-105 which quickly drops to normal or subnormal. These fluctuations in temperature occur at intervals usually not more frequently than twice in twenty-four hours. In the interval the patient is comfortable and appears to be greatly inproved. The red cells and hemoglobin are reduced and the leukocyte count is high. Metastatic lesions may occur late.

In the intravenous type the mastoid lesion is usually caused by a septic sorethroat, epidemic influenza or one of the exanthematous diseases. The signs of sepsis occur coincidentally with the appearance of mastoid symptoms , even before myringotomy.

High temperature, prostration and , at times, secondary lesions are present from the outset. The membrana tympani is red and often shows a bulge in Shrapnell's membrane. Discharge from the ear is scant and usually serosanguineous in character. The canal wall does not droop. Xray reveals a clouding of the mastoid process but intact intercellular walls. The culture may be sterile while the thrombosis is limited to the small vessels. Prompt intervention by the performance of a simple mastoid operation at this stage will usually cure the patient.

With the advance of the lesion a step further, there will be an osteothrombotic phlebitis. This will produce, in addition to the above symptoms, a marked reduction of the red cells and hemoglobin. The reduction progresses with each successive count. The blood culture should yield a Streptococcus hemolyticus. Surgical interventim

at this point should be in the form of a simple mastoidectomy followed by a blood transfusion to increase the hemoglobin.

When these measures prove insufficient, symptoms of sepsis persist and the prostration becomes increased. The reduction in the red cells and hemoglobin will continue and bacteremia will persist. The sinus wall presents a normal appearance. The diagnosis at this stage must be made from a persistance of signs and symptoms following the simple mastoid operation.

Determination of the side involved when there is a thrombosis with bilateral mastoiditis, is by no means an easy task. One must consider the appearance of the lesion at operation, the age of the mastoid pathology and various expedients, none of which are entirely satisfactory.

Ophthalmoscopic examination to determine the presence of engorged blood vessels on one side as compared to the other side may be of value. Gruening[21] reported a case of sinus thrombosis with bilateral mastoiditis in which the optic neuritis was more marked on the side of the lesion.

Primary Bulb Thrombosis is a term applied to an infected thrombus of the jugular bulb, the sigmoid and lateral sinuses not being affected in the initial stage.

Three pathways of infection may be noted here. From the labyrinth the septic process may extend through the internal auditory vein or the cochlear vein, through the floor of the tympanic cavity and by involvement of the carotid plexus of veins.

In infants[22] and young children the fissures, the thin lamella of bone and a rare dehiscence in the floor of the tympanum, each becomes an easy route and a constant menace.

Children so affected present typical symptoms and the physician should be constantly on the alert, in order that developing bulb thrombosis, may not be entirely overlooked.

It is ushered in by a sudden rise in temperature, even to 106, after which, the decline is as sudden as the rise. The fluctuations occur with some regularity. The child is fretful and shows signs of severe illness during the rise in temperature, but during the remissions, it may seem entirely normal.

In the adult, the symptoms differ little from other types of thrombosis if one remembers that a surgical mastoiditis rarely precedes the formation of the thrombus.

Cavernous Sinus Thrombosis is usually of nasal origin. When of otitic origin, it is to be viewed as a complication of sigmoid sinus or jugular bulb thrombosis. It makes itself evident by an involvement of the second, third, fourth and sixth nerves and by edema of the tissues surrounding the eye on the affected side.

In a case of cavernous sinus thrombosis in the practice of Dr. M. S. Ersner the patient presented symptoms which referred to both the mastoid and the nasal accessory sinuses as the point of origin. At operation, sinus thrombosis which had extended by way of the Superior Petros l sinus.

Lateral Sinus Thrombosis with Multiple Metastatic Abscesses

Case No. 3. Joseph Morein.

Man, aged 41, admitted to the Medico-Chirugical Hospital, service of Dr. G. M. Coates, December 12, 1924.

History: Six days before admission to the hospital the patient developed pain in his left ear. A myringotomy was done because of a bulging drum and there followed a free discharge of thin pus.

December 18, 1924. A simple mastoidectomy was performed by Dr.M. S. Ersner.

December 19th. Condition was good but he complained of pain in right arm.

December.22nd. The mastoid wound discharged a large amount of thick pus. The patient complained of severe headache.

December. 23rd. The patient complained of headache and appeared to be very uncomfortable. He had two chills one at 8:00A.M. and one at 2:00P.M., each very violent and lasting about eight minutes. Following the chills, the patient sweated profusely. The temperature became typically septic in character. The following day there was no chill and the patient seemed somewhat improved.

December 25th. The temperature continued septic and the patient had another chill about 1:00P.M His general condition seemed good.

On December 27th, following a chill, the patient felt better but complained of severe pain in the right arm. There was very little discharge from the mastoid

wound.

Two days later, December 29th, the arm had become painful and was somewhat red and swollen. Signs of beginning consolidation in the right lower lobe were noted. Blood culture, taken on the 27th was negative.

The following morning Dr. David Riesman examined the patient and reported a lobar pneumonia of moderate extent, right lower lobe. His examination of the right shoulder revealed a probable pus infection involving a large area. Mental condition dull.

During the following seven days there was little change in the condition of the patient. One very violent chill occured on January 3rd, 1925, which lasted thirty-five minutes. There had been no change in the pneumonia and the shoulder lesion showed no tendency to extend but fluctuation increased. Blood cultures were negative.

On January 7th, a blood transfusion was done.

Chilly sensations and remittant type of fever continued. A positive blood culture was obtained on January 20th.

Operation January 20th; under local anesthesia the mastoid wound was opened. The lateral sinus had been exposed by the pathological process and was found to be covered with a thick grayish exudate. During the removal of bone, in exposing the lateral sinus, the tip of the mastoid was removed. A distinct twitch of the face indicated that the facial nerve had been injured. The sinus was packed and incised. Bleeding was obtained from above but none from below. The internal jugular

was exposed and ligated.

Postoperative Course: There was no reaction following the operation. The next day the temperature dropped to normal. There followed, however, the usual rise and the septic type continued but with more gradual rises and falls. This was not the typical temperature of sinus thrombosis with the periodic sidcharge of septic material into the blood stream.

During the six weeks following the jugular ligation, the patient improved but it was necessary to incise and drain both the right shoulder and elbow. He was discharged from the hospital at the end of this time and returned, one month later, because of a localized collection of pus behind the left ear. The injury to the facial nerve at operation did not produce a paralysis. From this time his recovery was uneventful.

Laboratory Findings:

Blood count showed 4,800,000 with a hemoglobin of 75 on December 29th. January 25th there were only 2,800,000 red cells with 50% hemoglobin and one month later 3,140,000 red cells 60% hemoglobin. The white count varied from 8,500 to 16,650 the day before operation with 88 and 92 polymorphonuclears. Following jugular ligation the white count dropped to 8,900, 76% polymorphonuclears.

Blood culture reported on December 27th, January 5th, 13th and 20th revealed no growth.

Culture from the mastoid wound taken at time of operation, December 18th, was reported non-hemolytic streptococcus. Unfortunately, no report is

available of culture made from the shoulder and elbow streptococcus hemolyticus and staphlococcus aureus.

Examinations for syphilis, malaria, tuberculosis and typhoid fever were negative.

Comment: This case presents some of the features of an acute hemorrhagic type of mastoiditis. The early metastasis, occuring one week after admission, four days before symptoms of thrombosis, suggests the early discharge of septic material into the blood stream, possibly from some of the small tributary veins. There is also the possibility of a jugular bulb thrombosis which was present at the first operation. Dr. Ersner states that, at the simple mastoidectomy, the mastoid cavity appeared to be dark and congested and there was considerable bleeding. However there was the cellular destruction that one finds in the acute coalescent type of mastoiditis. In the mastoid cavity, a non-hemolytic streptococcus was found and in the abscess cavities caused by metastasis, a hemolytic streptococcus was reported by the culture. This suggests the possibility of two routes of infection.

A series of hemoglobin estimations would have been of value in this case. Following simple mastoidectomy, a progressive reduction in the hemiglobin would indicate further extension of the septic process (Thrombosis), while an increase would indicate that the process had been an acute hemorrhagic mastoiditis, the advance of which had been checked by the mastoidectomy.

The subject of brain abscess will be delt with only

by the report of cases at which the writer assisted, coming under the service of Dr. G. M. Coates at the Medico-Chirugical Hospital. The length of the paper would be increased to ponderous proportions if it were expanded to include even more than mere mention of the more important phases.

Much has been written in the recent literature regarding the treatment of brain abscess. One of the most important recent contributions is that of King.[23] His conclusions are as follows: 1. Various operative procedures, heretofore described, in which numerous kinds of drainage materials were used, have usually been followed by a high martality rate. 2. In all of these procedures described, prevention of hernia cerebri has been desired. 3. King's operative technic and post-operative treatment embrace the following: Creation of a rather large cranial defect diredtly over the abscess cavity; complete unroofing of the cavity; complete herni-- ation or eversion of the cavity; irrigation of the area under treatment with a surgical solution of chlorinated soda; prevention of trauma and early compression of the resultant hernia cerebri; and later, epithelization.

Dr. Ralph Butler[24] recently successfully operated on a brain abscess using the technic of Dr. King. The patient made an uneventful recovery and has remained well for about a year except mild attacks suggesting Jacksonian Epilepsy.

Yerger[25] believes that the ideal operation should be done through the avenue of infection, the mastoid and tympanic cavity, because: 1. It is less dangerous. 2. I

the majority of cases nature has already "cofferdammed" this approach to the abscess by sealing off the sub-arachnoid space. 3. This route gives evidence of location of the abscess (reddish area of meningitis, granulations on the dura, the fistulous connection with the diseased bone, and the localized bulging of the dura with lack of pulsation). 4. The site of the brain abscess is most often found near the diseased bone. 5. It gives the best drainage on account of gravity. 6. The causative infection should also be cleaned up.

In acute abscess with no limiting wall, Elsberg[26] has performed a radically changed operation. As soon as the pus has been located with the exploring needle, and while the needle is still in place, the opening in the bony skull is enlarged, the dura widely opened and a modified Mikulicz tampon inserted into the cavity.

Eagleton[27] has been successful with his method of osteoplastic flap formation. He believes that slow, painstaking work, from the first nick in the dura to its complete closure, is of primary importance. The intra-dural work should be performed with as much delicacy and attention to detail as are required during the extraction of a cataract.

Cases Illustrating Brain Abscess:

No. 4. Helen Gealt
No. 5. James Ronzo
No. 6. Iseral Sperling
No. 7. James Murphy

Case No. 4.
Helen Gealt.

Brain Abscess Following the Acute Coalescent Type of Mastoiditis.

Girl, aged 11, admitted to the service of Dr. G. M. Coates under the care of Dr. M. S. Ersner, Medico-Chirugical Hospital, March 27, 1925.

History: About two years before admission, the patient had an attack of acute otitis media of the left ear. This was relieved by a myringotomy and removal of the tonsils and adenoids. From that time until the present attack, she complained of headache.

The present attack began about two weeks before admission with an acute suppurative otitis media of the left ear. Myringotomy relieved the symptoms for a few days. There followed, then, pain in both eyes with a slight swelling of the left lid. There was tenderness over the left mastoid region.

Physical examination upon admission revealed nothing except tenderness over the mastoid area. Fundus examination made by Dr. Mershon was as follows:- O.D. Vessels slightly smaller and more tortuous than normal. Retina shows slight pallor. O.S. Vessels markedly contracted, slightly tortuous, and of about the same color. Retina pale, due to pressure on blood supply. Blood count: 3,730,000 red cells, 18,500 leukocytes, hemoglobin 60, polymorphonuclears 87, small and large lymphocytes 11 & 2. Temperature 102, pulse 114, respirations 18.

Operation: March 28, 1925. Dr. Ersner made a diagnosis of acute mastoiditis with the possibility of some intracranial complication. Single mastoidectomy was

done on the left side. The mastoid cavity presented the appearance of an acute coalescent type of the disease. A thin pus was present, the cell walls showed some destruction and the sinus wall appeared dark in color. The sinus was uncovered and found to be normal. The dura was exposed over the tegmen antri and found normal.

Following operation there was a typical reaction, The temperature reaching 104. There was little change the next day. The temperature dropped to 101 and fluctuated between that and 102 for the next three days. Culture made on pus from the mastoid revealed a streptococcus hemolyticus.

March 30th there appeared a slight weakness of the muscles of the left side of the face.

During the week following there was little change in the condition of the patient except that she complained of pain in the left eye and left frontal headache.

On April 18th the patient became extremely noisy, screaming with pain in the left side of the head. There was ptosis of the left eyelid. Temperature normal, pulse 68.

This condition continued until April 22nd, when it was noted that the ptosis of the left eyelid had become more marked and the left side of the face was drawn toward the right. Double vision, inability to rotate the left eye out and pain over the distribution of the fifth nerve, indicated the eymptom complex of Gradenigo. Knee jerks were absent and there was a suggestion of a positive Kernig. Neurological examinations by Drs.

Weisenburg and Yaskin revealed paralysis of the right sixth and the left third nerves, rigid neck, bilateral Kernig and Babinski, left facial paralysis, confusion and delirium. Their impression was, that the lesion was a basalar meningitis. A spinal puncture was done and 20cc of clear fluid withdrawn. There was a slight increase in pressure, cells 5, protein not increased, sugar positive, Wasserman negative, Colloidal Gold .0002332100,

The following day the patient was improved. On the 25th another spinal puncture was done and laboratory report showed nothing in addition to above. TB. negative. Animal inoculation: Animal died on fourth day and revealed no lesions.

A spinal puncture on May 3rd relieved the patient for one day but pain returned and she became noisy.

On May 5th Dr. Shuster did the caloric tests with normal findings. Blood culture was reported negative.

Xray report of sinuses: Slight haziness of the left frontal sinus. Ethmoids on both sides occluded with exudate. Maxillary and sphenoid sinuses are clear.

There was a small swelling over the zygomatic ridge, just anterior to the tragus, noted on May 7th.

Dr. Grant examined the patient on May 8th and made the diagnosis of basalar meningitis with blocking of the ventricles.

Second Operation by Dr. M. S. Ersner: A positive diagnosis could not be made. Because of the opinions of the neurologists, Drs. Weisenburg and Yaskin, and of Dr. Grant, that the condition was a basalar mening-

itis, Dr. Ursner felt that surgical intervention should not be undertaken until there was a more definite indication. This indication he believed to be the swelling over the sygoma. An incision was made over the line of the old scar. The incision was extended well forward over the zygoma. Periosteum was elevated and granulation tissue cleared from the wound, carefully avoiding injury to the exposed sinus. The zygomatic region was inspected and a fistula, too small to carry a probe, was located at the root. From this region a small amount of pus exuded. Necrotic bone about the fistula extended into the mastoid region and inward to the dura. The dura was exposed by following the route of the infection, the fistulous tract. A large area was exposed until normal dura was reached. It was under great tension and marked bulging was noted. The region was explored for an epidural abscess but none was located. Two stab wounds were made. One forward which caused a small amount of pus to exude, probably by pressure upon the sack, and one back. The surgeon felt a distinct resistance and the release when the knife encountered and entered the sack. There was an immediate welling up of pus under great pressure. A grooved director was inserted and two ounces of pus recovered. A rubber tube was inserted along the grooved director and the wound dressed in the usual way.

There was a slight postoperative rise in temperature [illegible], following this, the progress was uneventful until [illegible]

usual depth. A grouved director was carefully inserted, the tract enlarged and about an ounce of pus recovered. This was followed by immediate improvement.

May 19th there appeared to be an improvement in the eye condition. The diplopia was not so annoying or constant. This symptom finally disappeared and recovery was uneventful.

Fundus Examinations:- by Dr. Mershon- April 22nd, "Media of both eyes was clear. O.D. All vessels quite tortuous. O.S. Vessels tortuous, disc outline almost obscured--with some edema of the retina. No hemorrhage was present. Evidence of pressure symptoms otherwise marked. Diplopia."

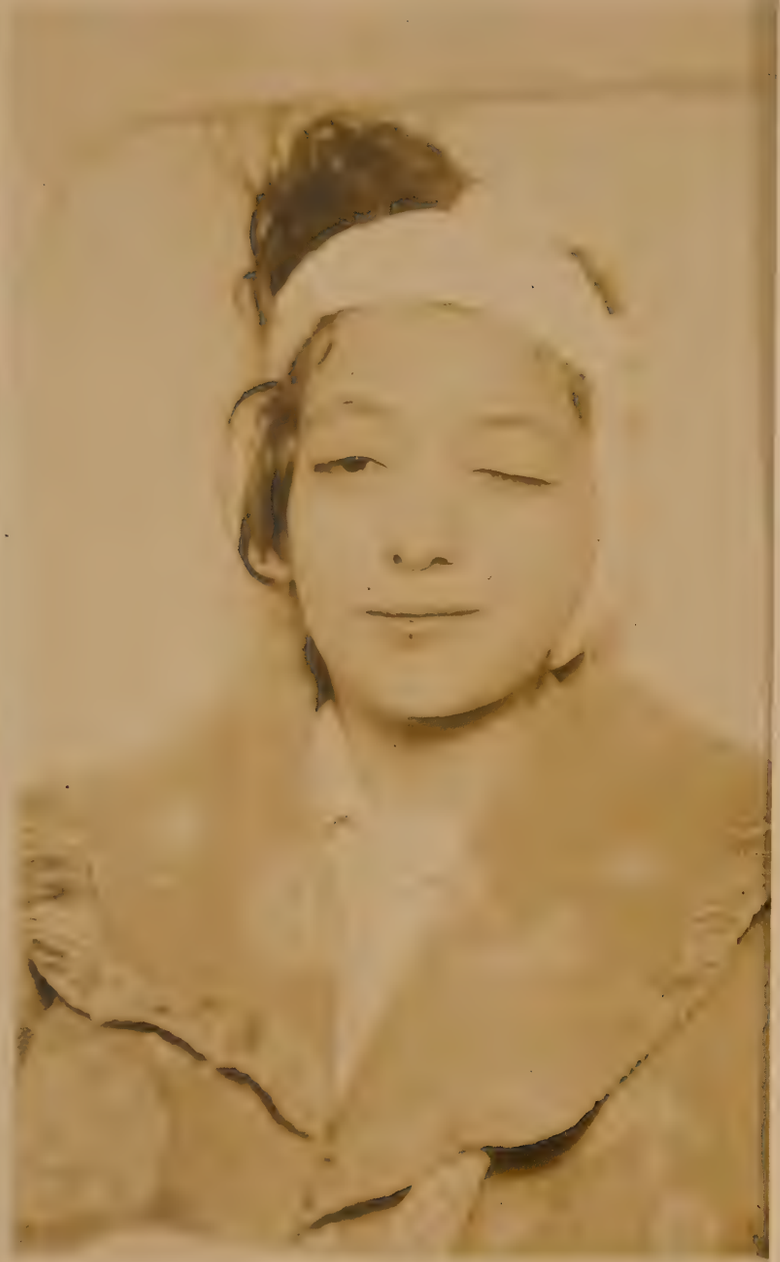
April 27th. O. D. Veins engorged--disc outline entirely obliterated. Pressure symptoms in eye increasing.

May 7th, by Dr. Fox, O. D. Practically normal. Slight suspicion of optic neuritis as evidenced by the full veins and narrowed arteries. O. S. Marked optic neuritis as evidenced by bulging head of nerve forward into vitreous.

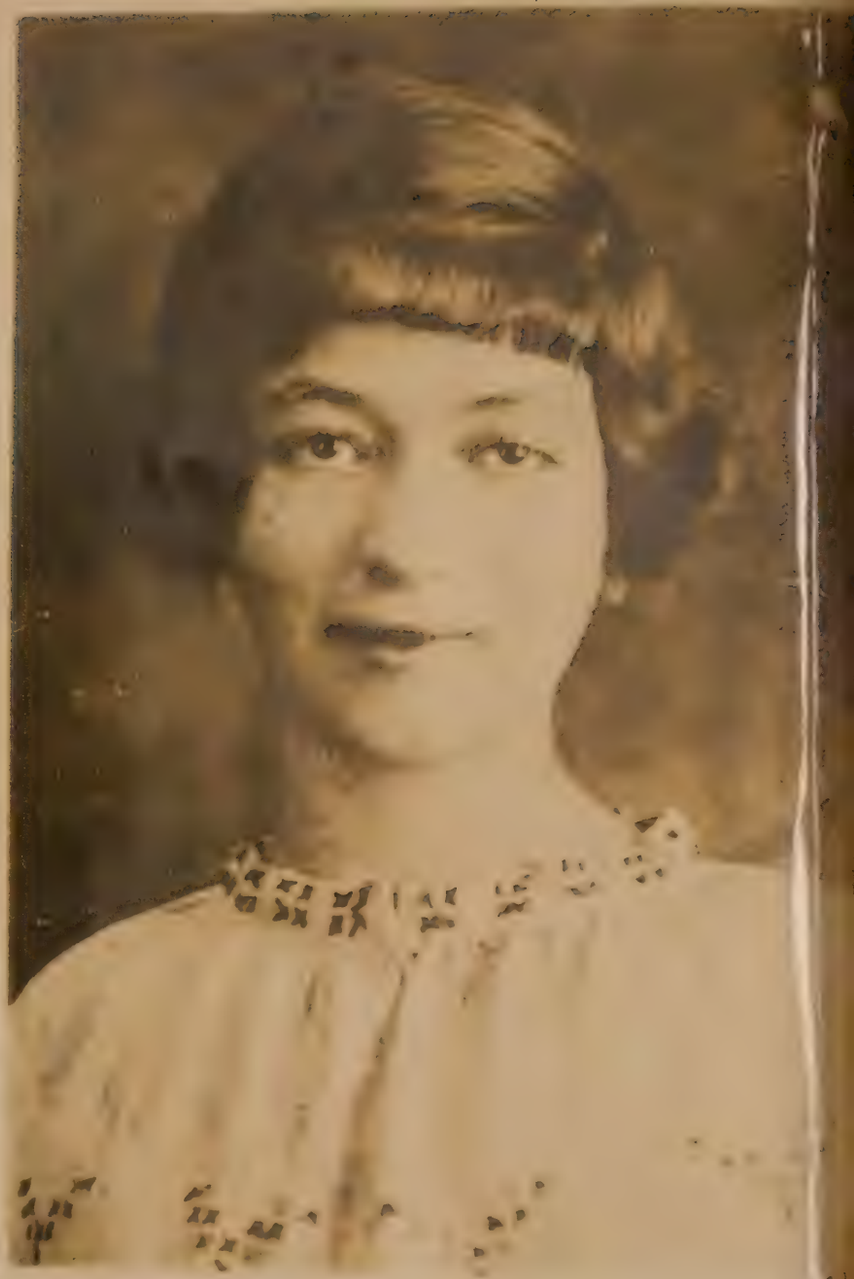
May 27th, Vessels more normal in appearance. Disc outline slightly visible. Ptosis decreased. Exopthalmus less.

Comment: This case presented a distinct problem in diagnosis. Operation was delayed because of divided opinion. The neurologists and brain surgeon on one hand, believed that the condition was one of a [illegible]

At time of operation



Three weeks after operation



Seven months after operation

lieved the case to be a brain abscess. The opinion of the neurologists is extremely valuable in any case, but it should always be supplemented by the opinion of the experienced otologist whose viewpoint from the clinical side is invaluable.

That the abscess was chronic and of long duration is indicated by the sterile contents and the thick limiting membrane. The exant duration becomes a question, when one considers the history of previous otitis media and a chronic persistent type of headache following this for a period of two years. It is altogether possible that an acute infection in the mastoid could cause a lighting up of the infection with an increase in symptoms caused by the abscess.

The collection of pus in the abscess cavity the second time indicates the necessity for care in keeping the tract open and abscess draining.

Temperosphenoidal Abscess Following Mastoiditis; Death

Case No. 5.

James Ronzo

Man, aged thirty-nine, was admitted to the service of Dr. G. M. Coates, July 8, 1925.

History: Six weeks before admission, following violent sneezing, the patient felt something snap in his right ear. From this time he dates the onset of

headache referred to that side.

Two days following admission, July 10, 1925, a simple mastoidectomy was performed by Dr. M. V. Miller. Nothing unusual was noted at this time.

For ten days following the operation the condition of the patient was good. Pulse, temperature and respirationswere practically normal, except on the 13th, when the temperature reached 100 and remained up for twenty-four hours, then becoming subnormal.

On July 23rd there was a sharp rise in temperature to 101, pulse 100, respirations 22. The patient complained of frontal headache, general malaise, and chilly sensations. The right pupil was larger than the left. The wound was enlarged and packed with a dressing wet with Dakin's solution. The temperature gradually declined and reached normal July 24th, and from this time fluctuated between 100 and 99 for three days, pain becoming worse.

On July 27th there was a sharp rise in temperature to 102.8, pulse 68, respirations 22. The patient complained of severe frontal headache and general weakness. Examination revealed general muscular weakness, and the right pupil was dialated and reacted sluggishly to light. The jaw and the tongue deviated to the right. There was a left facial weakness of the central type. The patellar reflexes were greatly exaggerated, the left more than the right. There was a definite Babinski and ankle clonus on the left side. The Kernig was positive.

July 28th. Summary of an examination by the neurologist Dr. Yaskin follows; There is evidence of meningeal irritation and fairly definite involvement of the left pyramidal tract, with probable indirect pressure upon the right. There is hypermetria of the left hand. Impression: Localized meningitis or early brain abscess of the right side. Eye examination by Dr. Mershon: Media all clear. Vessels of normal size. Eye grounds negative.

July 29th. There was little change. The temperature came gradually to normal and the pulse reached 64. Rigidity of the neck, Kernig and pain all increased. Headache worse on right.

July 30th. Operation by Drs.Miller, Ersner and Shuster. An incision was made through the old wound. Clot and granulations removed. The lateral sinus was exposed and found to be normal. In the zygomotic region, pus was noted ecuding from a fistula which extended downward and forward into the middle fossa. The dura over the middle fossa was exposed by following the fistula and was not under marked tension and no pulsation was noted. A hemostat was inserted along knife blade and about an ounce of chocolate-colored pus with an offensive odor was recovered. The dura was exposed over an area of about an inch and a half into the abscess cavity and brought out along the fistulous route behind the ear.

About a half hour after returning from the operation, quick convulsive movements were noted in the left hand and arm. The patient was in a semi-comatose state after recovery from ether until the next morning when he died at 3:30.

Autopsy revealed a chronic abscess about the size of a hens egg limiting wall in the temperosphenoidal lobe. At the junction of the superior petrosal and lateral sinuses, there was a small fissure, leading from the mastoid cavity into the middle fossa. In this region there was considerable necrosis of bone. The pus had worked its way beneath the tentorum into the posterior fossa. The cerebellum and brain stem were covered with pus.

Laboratory Findings:-

23rd.	Leukocytes	7,950				
27th	"	13,700	Poly.80,	Trans.5,	SL 15	
29th	"	8,900	75	1	17	LL6

Reds 4,270,000 Hb. 90

Comment:- This case presented very definite symptoms of brain abscess and was so diagnosed before operation. The abscess, chronic in type, must have been present for some time before the mastoidectomy, however, careful search did not reveal any fistula. The mastoid cells were intact and filled with a thin serum giving one the impression of the hemorrhagic type of mastoiditis.

Case No. 6.

Iseral Sperling

years the discharge had been scanty but malodorous.

On admission to the hospital the patient complained of a persistent dizziness. Barany tests were done and disclosed a dead right labyrinth and involvement of the left. Because of these symptoms and signs a radical mastoidectomy was done on the left side, June 11th.

Recovery was uneventful and the patient was discharged from the hospital in eight days.

Shortly after removal to his home, he showed difinite mental symptoms, refusing to talk and acting peculiarly.

He was again admitted to the hospital June 23rd. He appeared to be confused, refused to talk and seemed indifferent to surroundings.

The day following admission the patient appeared dull but stated to the writer that he had pain over the left side of his head. Spontaneous mystagmus was noted. This was made worse when eyes were rotated to the right. A left sided facial paralysis was present.

On June 26th a neurological examination was made by Dr. Patton who reported that there was no evidence of organic nervous disease except total deafness and left facial paralysis. Eye grounds negative. During the night a Jacksonian convulsion was noticed. It was limited to the right face, arm and leg. Head and face were pulled to the right, and the right upper and lower eyelids twitched. The convulsions continued for five hours at about five minute intervals.

Drs. Babler and Bailey examined the patient on the next day, June 27th, and noted a paralysis of the right arm and leg, deviation of the tongue to the right and [illegible]

mental dullness. Evidence of a left motor cortical irrigation was present, and exploration was advised. Temperature 99, pulse 62.

Operation June 27th by Dr. M. S. Ersner:- The mastoid scar was excised and the incision extended upward and forward. Granulations were removed from the mastoid wound. A large fistula of the external semicircular canal was noted. An area of dura about two cm. in diameter was exposed over middle lobe. The dura appeared normal and was not under tension. Three stab incisions were made with a brain knife and about five cc. of a malodorous pus was recovered. A rubber tube was inserted and wound dressed.

Postoperative course: The patient did not react well after operation. The temperature became subnormal and he appeared to be shocked. Within three days he gradually improved and on June 30th appeared much brighter mentally. Speech was thick and of hemiplegic type. Paralysis of right arm and leg showed no change. The following day he appeared toxic but fairly lucid.

On July 3rd the patient became cyanotic with definite signs of pulmonary edema and died on the morning of July 4th.

Comment:- This case illustrates the type of acute abscess without limiting wall. It progressed rapidly with no checking from operative interference. This brings up the question of the more radical operative procedure of King, the results of which are better in acute cases.

Case No. 7

John Murphy

Painless Type of Mastoiditis Followed by Brain Abscess and Sinus Thrombosis.

White male, aged 26, admitted to Medico-Chirugical Hospital, service of Dr. Coates, under the care of Dr. B. H. Shuster, Dec. 4, 1925.

History:- The patient had an attack of pneumonia two months before admission. Following this the patient had an attack of acute exacerbation of a chronic suppurative otitis media. A polyp was removed from the ear and following this for four weeks to date of admission there was a profuse discharge of pus from the right ear and occasional attacks of pain. The patient lost about twenty pounds in weight.

Examination: The right ear showed a profuse yellowish discharge. There was no pain, tenderness or swelling over the mastoid. Temperature, 103, pulse 86, respiration 22.

Laboratory examination: Urine negative. WBC 9200 with secondary anemia. Spinal fluid not under tension, clear and cells 100 per cc.

The patient presented symptoms of lateral sinus thrombosis. About every eight to ten hours the patient had a severe chill which was followed by high fever and great prostration. In the intervals the patient was comfortable and temperature ran near normal. There was pain over the emissary vein and tenderness along course of jugular vein.

Operations:- A radical mastoidectomy was done on t[illegible]

right side by Dr. B. H. Shuster, local anesthetic being used. At this time the intemal jugular vein was ligated, the lateral sinus exposed and incised. Pus was found and traced to the jugular bulb. There was bleeding from above but not from below. The wound was packed with iodoform, gauze and dressed open.

For about a week following the operation the patient did very well. Then began symptoms pointing to brain abscess. The patient became dull mentally, confused and irritable. Nystagmus to right was present, but not marked. Pulse became slow and irregular. The patient complained of pain on the right side of head and tenderness was found on percussion over this area. The left arm and leg developed spastic paralysis following facial parasis on left side.

Second operation:- A trephine opening was made above tegmen antri and enlarged by rongeurs. In this region an area of granular dura indicated the pathway of infection. A malodorous pus was found in the tempero-sphenoidal lobe. Smear showed a diplococcus but culture was negative. The abscess was drained with a rubber tube.

The postoperative course was a stormy one, and the patient died five days after operation.

Autopsy:- The dura at the point of entrance to abscess showed an area of infiltration and tough granulations evidently produced when abscess worked its way over tegmen antri. The lateral sinus infection extended to torcular and was dilated to an inch in diameter. An abscess cavity about the size of an egg was noted in the tempero-sphenoidal lobe. It communicated with cystmea and horn of lateral ventricle. The abscess perforated upward, and there was

a sub-dural abscess about four inches in diameter. There was pus in median fissure. There was present no basilar meningitis, no involvement of cerebellu, or cavernous sinus of left side.

Comment:- This case illustrates the many complications which may occur in a mastoiditis of the chronic type which has suddenly become the seat of an acute attack. A lateral sinus thrombosis was probably the first complication and this involved the jugular bulb. It progressed after operation and by the sinus route the brain abscess occured.

Autopsy revealed the hopelessness of surgery in this case. The poor resistance of the patient following pneumonia was very probably a factor in the rapid spread of the infection.

That there is a painless type of mastoiditis should be kept in mind in the diagnosis of a surgical mastoid.

Summary and Conclusions

1. Although certain surgeons have reported favorable results in the treatment of meningitis there is no positive evidence that these cases were not of the circumscribed variety.

2. In the acute coalescent type of mastoiditis operative measures should not be undertaken, as a rule, before ten days or two weeks have elapsed from date of onset.

3. The discharge of a large amount of pus from the middle ear or mastoid wound should lead one to suspect further extension of the disease process and proper operative measures should be instituted to prevent intracranial complications.

4. The otologist in his zeal to treat the local condition should not fail to realize that proper measures directed toward the building up of the general health will greatly aid in cleaning up a postoperative mastoid fistula.

5. Certain cases of mastoiditis present features of both the acute coalescent type and the acute hemorrhagic type.

6. Hemoglobin estimations are of sidtinct value in cases of mastoiditis aiding in the diagnosis of intracranial complications and the differentiating between the coalescent and hemorrhagic types.

7. In the diagnosis of the surgical mastoid, the painless type of mastoiditis should be kept in mind.

8. In the diagnosis of brain abscess of otitic origin the opinion of the neurologist is extremely valuable, but it should be supplemented by the opinion of the experienced otologist whose viewpoint from the clinical side is invaluable.

9. Brain abscess of the chronic type can frequently be successfully delt with by operation through the fistulous tract by the insertion of a simple drainage tube. The acute or multiple abscess with no limiting wall requires more radical operation of King, Elsberg or Eagleton.

10. Because of the danger of early expulsion of the tube, closure of the tract and shifting of the tube some means of anchoring the tube in place should be used.

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